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DATE: July 27, 2009

TO: Gary Newhart, U.S. EPA/ERTC Work Assignment Manager

THROUGH: Dennis Miller, REAC Program Manager

FROM: Christopher Gussman, REAC Task Leader

SUBJECT: PILOT STUDY JULY 2009 EVALUATION
LOWER SILVER CREEK TAILINGS SITE
WORK ASSIGNMENT No. 0-300
TRIP REPORT

Introduction

This trip report summarizes the start up of a pilot scale study at the Lower Silver Creek Tailings Site initiated on May 11, 2009. In November of 2008, Lockheed Martin Response Engineering Analytical Contract (REAC) personnel were tasked to chemically and agriculturally characterize soil provided from the site. Part of this evaluation was to determine the effect of a locally available biosolids compost source and another organic compost on the soil chemistry and plant growth in these soils. Contaminated soil (tailings) cover a large area of the site, and an effective way to revegetate the area and/or bind metals of interest would be more economic than removal. The current goal is to observe the effects of the amendment in the field *in situ*, and to compare different amendments and amendment application rates on the growth and long term establishment of native vegetation.

REAC personnel, the U.S. Environmental Protection Agency (U.S. EPA) Work Assignment Management (WAM), and a representative of the U.S. Fish and Wildlife Service, under guidance of Region VIII EPA, initiated the pilot scale trial on May 11, 2009. An area of tailings typical of the area was selected, and a 75 feet by 100 feet pilot study area was created. This pilot study area was divided into fifteen 25 feet by 20 feet subplots allowing five treatments placed by a complete randomized block design with three replications. An additional, smaller experimental plot (five 10 feet by 10 feet blocks, not replicated) was also set up on an area of barren tailings.

In July 2009 the REAC task leader, ERT WAM and U.S. Fish and Wildlife Service representative returned to the Site to evaluate the initial growth and establishment of vegetation and check the overall status of the Site.

Background

From the mid-1800s through the 1970s, this region was extensively mined for silver and lead ores. Although some remediation has occurred, residual deposits of tailing wastes remain in place along large sections of the Lower Silver Creek. Bed sediment samples were collected by the USGS in 1998, 1999, and 2000 and analyzed. Water samples were collected in March and August 2000 and were analyzed for total and dissolved trace metals.

Concentrations of silver, cadmium (Cd), copper (Cu), lead (Pb), mercury (Hg), and zinc (Zn) in the streambed sediment of Silver Creek greatly exceeded background concentrations. The levels of these metals also exceeded established aquatic life criteria at most sites. In the Weber River, downstream of the confluence with Silver Creek, concentrations of Cd, Pb, Zn, and total Hg in streambed sediment also exceeded aquatic life guidelines, however, concentrations of metals in

concentrations of Zn, total Hg, and methylmercury in Silver Creek were high relative to unimpacted sites, and exceeded water quality criteria for the protection of aquatic organisms. Qualitative measurements of the macroinvertebrate community in Silver Creek were compared to the spatial distribution of metals in streambed sediment. The data indicate that impairment related to metal concentration exists in Silver Creek.

The Lower Silver Creek Tailings Site extends over 12 miles along the banks of Silver Creek, from State Route 248 north of Richardson Flat, two miles east of Park City, Summit County, Utah. The site has been subdivided into southern and northern portions, due to the site conditions and topography. The northern portion of the site consists of a narrow corridor located between the lanes of interstate 80 (I-80) which includes the rail trail, Silver Creek and the riparian habitat. The southern portion of the site is approximately 4.4 miles in length between Atkinson and State Route 248, and is as much as 2,500 wide, east to west. The southern portion of the site upstream from Atkinson is being developed by residential and commercial expansion.

The headwaters of Silver Creek are located upgradient of Park City. Silver Creek is the primary drainage within the watershed downstream to the Weber River confluence in Wanship, Utah. The Weber River is considered a Class 4 (agricultural), 3A (cold water fishery), 2B (contact recreation), and 1C (source of drinking water) river. Silver Creek is considered a Class 3A, 1C and 4 stream.

Mine tailings generally cover the entire southern portion of the Lower Silver Creek. Tailings are readily apparent in the non-vegetated gray colored sandy and gravelly mounds and low ridges within the riparian habitat along Silver Creek. Elongated berms trend north-south and are found throughout the entire southern portion of the Lower Silver Creek.

The northern portion of the Lower Silver Creek is a generally well vegetated riparian habitat. A beaver dam was observed upstream from Alexander Canyon. Fish were observed in Silver Creek at a few locations. Various bird species have been reported along the banks of the Silver Creek. Mine tailings have reportedly not been observed more than one mile north and downstream of Atkinson.

The area impacted by this site is too large for conventional treatment such as removal. It is anticipated that compost and possibly other soil amendments may be utilized to enhance vegetative cover establishment at the site and possibly reduce mobility of the metal contaminants. In January 2008, REAC scientists performed a laboratory test to examine growth of plants and metal concentration on four soil samples obtained from Lower Silver Creek. The studies indicated that the plant growth was problematic but plant health and vitality were improved with supplemental compost and phosphorus. The next step was to create a pilot scale revegetation effort on the tailings *in situ*. Plant growth and species diversity could then be observed under natural site conditions and any potential problems identified and corrected before going full scale. Additional data, such as metal mobility and carbon sequestration rates may also be obtained from these pilot plots at a future date.

Activities

REAC personnel arrived at the site on the afternoon of Wednesday, July 8, 2009. Overall condition of the site was excellent. Fencing was intact, straw mulch was still evenly distributed, and germination and growth of the seed mixtures was readily visible even from the road. In addition, differences in growth of the different treatments was readily apparent (Figures 1 and 2, Table 1), both from the road and at close inspection. Vegetative growth was very good with certain treatments even on the small plot of previously barren tailings (Figure 2). Initial observations suggest that the tailings will support relatively normal plant growth after the addition of an organic amendment. Additional study is needed to see if the plant growth continues to remain dense after multiple growing seasons, if plant species diversity is maintained, and the effect of growing plants and organic amendments on the mobility of the metals on site.

Overall, Treatment A (Untreated Control) supported minimal growth. Germination was apparent but was sparse and plants were small, undercolor and stunted compared to other treatments. From a distance, Treatment A plots appeared barren and very little green color was apparent. Treatment B (10% Biosolids Compost) was one of the best treatments, almost equal or equal with Treatment E (10% Biosolids Compost + 10% Leaf Compost). Treatment C (20% Biosolids Compost) performed respectively on the main plot, though not better than Treatment B (10% Biosolids Compost). A B E

However, Treatment C performed considerably poorer than the other treatments [except the Treatment A (Control)] on the smaller plot located on the barren tailings. Unfortunately there is no replication on this plot, and it can not be determined if these results would be consistently replicated. Treatment D (10% Leaf Compost), although better than the control, performed extremely poorly. The plants probably benefitted from the additional nitrogen in the Biosolids Compost that is not present in the Leaf Compost. A combination of the two compost types (Treatment E) performed quite well.

The plant growth was represented by a nice mixture of predominantly grasses, but various dicots and possibly some sedges were also readily apparent. In addition, the Baltic Rush was regrowing in the larger plot, although difference in its growth and coloration from plot to plot was also readily apparent. There are a few areas on the main plot where the density of the baltic rush was very naturally higher than others (e.g. the eastern half of "A1" continuing into the western half of "C2".

Based on the analytical results, the unvegetated tailings do not seem to be greatly different from the main plot except in their lower organic matter content. This organic matter may be assisting in binding toxic metals as well as holding in moisture, resulting in establishment and growth of at least one species of plant (Wiregrass).

The plots were photodocumented on July 8, 2009, seven weeks after seeding. On July 9th , the EPA On Scene Coordinator also visited the pilot test plots. At that time he received copies of the May 2009 trip report, which details the plot set up and contains the results of chemical and soil fertility data for each plot.

Future Activities

Future activities will continue to evaluate the success of the pilot scale study. Success of the revegetation effort and the ability to bind metals of concern and sequester carbon will be more closely examined. It is anticipated that another trip will be made to the site in September 2009 to perform a more detailed evaluation of the plot success and compare different treatments, including carbon sequestration rates. Additional treatments may also be evaluated in the field or laboratory based on current findings and additional discussion.

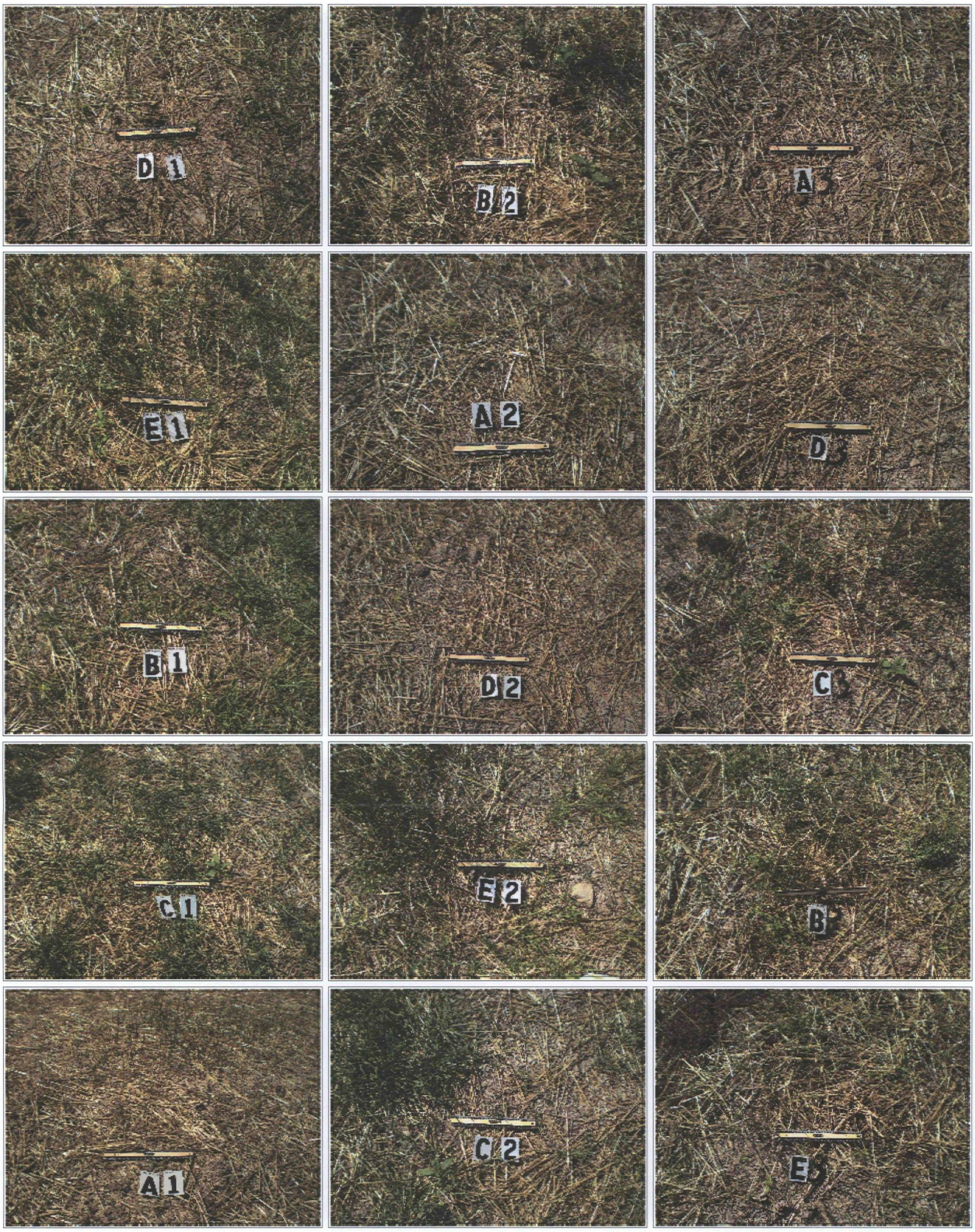
Tables

Tables

Table 1: Observation of the Main Pilot Revegetation Plot July 8, 2009.

Cell Location	Percent Vegetative Cover	Comments
A1	5-10	Sparse. Wiregrass/seedlings small, undercolor. Wiregrass dense on eastern portion of the plot. Growth is very sparse on western portion of the plot.
A2	5-10	Poor Germination. Plants stunted and yellow.
A3	5-10	Poor germination. Plants stunted and yellow.
B1	20-25	Best of group 1. Dense cover except western portion. Good coloration especially on the center and eastern portion of the plot.
B2	10-15	Wiregrass Good. Germination and color good but not evenly distributed. Some plants, including some dicots, show excellent coloration and growth, while others remain small and chlorotic.
B3	10-15	Plants small but fair coloration on both monocots and dicots.
C1	15-20	Wiregrass sparse but evenly distributed. Some plants very dark green and large, others smaller and undercolor.
C2	10-15	Uneven distribution. Some parts of the plot have good coverage and coloration, but other areas have poorer coverage and coloration.
C3	10-15	Plants small but coloration very good.
D1	5-10	Wiregrass ok but seedling germination poor and seedlings are very chlorotic.
D2	5-10	Seedlings very chlorotic. Wiregrass coverage is thicker on the western border where it meets A1.
D3	5-10	Small, chlorotic seedlings. Wiregrass small.
E1	15-20	Good distribution of seedlings and wiregrass. Fair coloration but individual plants smaller and poorer coloration than B1.
E2	15-20	Plants smaller size but uniform. Coverage somewhat uneven.
E3	10-15	Wiregrass looks fair. Seedlings are slightly undercolor.

Figures



Legend

Treatments
A: Control (Untreated)
B: + 10% Biosolids Compost
C: + 20% Biosolids Compost
D: + 10% Leaf Compost
E: + 10% Biosolids Compost + 10% Leaf Compost

← Creek
Road ↓

Note:
Ruler in photo is 1 foot.
Actual plots 20 feet by 25 feet.
Photos taken July 8, 2009 - 7 weeks after seeding.

Data: g:\arcviewprojects\reac4\00-300
MXD file: g:\arcinfoprojects\reac4\EAC00300_LowerSilverCreek\300_Pilot_Revegetation_Study_Plot1_f1rev001
Revision Number: 001

U.S EPA Environmental Response Team
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Figure 1
Pilot Revegetation Study Plot
Lower Silver Creek Tailing Site
Park City, Utah
July, 2009

Legend

Treatments

A: Control (Untreated)
B: + 10% Biosolids Compost
C: + 20% Biosolids Compost
D: + 10% Leaf Compost
E: + 10% Biosolids Compost + 10% Leaf Compost

Note:
Ruler in photo is 1 foot.
Actual plots 10 feet by 10 feet.
Photos taken July 8, 2009 - 7 weeks after seeding.

← Creek
Road ↓

Data: g:\arcviewprojects\reac4\00-300
MXD file: g:\arcinfoprojects\reac4\EAC00300_LowerSilverCreek\300_Pilot_Revegetation_Study_Plot2_fXrev001
Revision Number: 001

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Figure 2
Pilot Revegetation Study Plot
Lower Silver Creek Tailing Site
Park City, Utah
July, 2009